

A BRIEF (ONE-HOUR) QUANTITATIVE NEUROPSYCHOLOGICAL
ASSESSMENT WITH THREE PERFORMANCE-BASED TESTS:
STRONG CONCORDANCE WITH PROFICIENCY SCORES
FOR A MORE EXTENSIVE TEST BATTERY¹

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Summary.—Raw scores for each of several dozens of traditional and more recently developed neuropsychological tests were correlated with an impairment index composed of all of these scores from the records of 162 patients who had been assessed following impacts of substantial mechanical energies. A score of either less than 20 correct binaural responses for a dichotic word listening task, more than 99 sec. for Trails B, and more than 3.8 min. to complete the Tactual Performance Test with both hands correctly classified 85% of patients whose *z* scores were less than -1.0 (below average) or -1.0 or above (average) for a composite neurocognitive index. The results suggest that these three tests, administrable within about one hour, may be employed as a more objective criterion rather than "clinical impressions" for discerning if patients require more extensive neuropsychological testing.

According to contemporary definitions, the impact of mechanical energies upon the skull is considered injurious and potentially incapacitating only if the person displays a verified cessation of consciousness following the impact or exhibits neurological sequelae discernable during brief qualitative assessments (Persinger, 1995a). However, consensual definitions, regardless of the prestige of the originating body, do not replace the validity of empirical measurement.

The difficulties adapting exhibited by patients (Persinger, 1993, 1994) subsequent to the impact of mechanical energies to their bodies or skulls, particularly if there was no induced unconsciousness, have been labelled as postconcussional syndrome, posttraumatic syndrome, and even variants of neurosis. The policies of some insurance companies, which powerfully affect state and provincial legislation concerning the definition of impairment and the patient's qualification for financial benefits, classify as impaired only patients with conspicuous neurological symptoms and severe neuropsychological deficits. This dichotomous approach ignores the existence of a quantitative continuum of brain dysfunction that occurs in parallel with the continuum of vectors of mechanical forces that impact millions of human crania each year (Persinger, 1995b).

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The analytical purpose of the present study was to discern whether a single measure, particularly the accuracy for dichotic word listening, was strongly correlated with impairment scores composed of dozens of tests that required two days to administer and complete. The humanistic purpose of this study was to identify any combination of a small subset of performance-based tests whose scores maximally approached the accuracy of the complete neuropsychological assessment so that patients who did not display conspicuous clinical deficits might be screened more quickly. This brevity might encourage clinical neuropsychologists to pursue thorough assessments rather than to rely upon the frequent practice of attributing the patient's difficulties to psychological problems, learned helplessness, or compensation syndrome.

METHOD

Subjects

A total of 162 patients (86 men; 76 women) between the ages of 15 and 65 years, who had been referred for thorough neuropsychological assessments because of the impact of significant mechanical energy to their bodies or skulls, participated. For most of these patients, the source of the mechanical energy had been from an impact due to a sudden acceleration or decrease in velocity during the operation of a motor vehicle. The characteristics of this general population of patients have been reported elsewhere (Persinger, 1995a, 1999). The proportions of patients with Halstead Impairment Index scores of 0–.2, .3–.4, .5–.6, .7–.8, and .9–1.0 were 19%, 19%, 16%, 31%, 9%, and 6%, respectively. Eighty-eight percent of the patients were less than 51 years of age.

Procedure

All patients had been administered the Wechsler Adult Intelligence Scale (Revised), the Wide Range Achievement Test–2, the Wechsler Memory Scale, the Halstead-Reitan Neuropsychological Test Battery (Reitan & Wolfson, 1985), and several additional neuropsychological tests (Persinger, 1999) including a dichotic word listening test. It contained 50 words. Raw scores for these tests were correlated with the standardized score for the Laurentian University Neuropsychological Index, an inference of neurocognitive proficiency (Persinger, 1999). It is composed of the mean of *z* scores for 33 performance-based tests. All analyses involved SPSS software on a Vax 4000 computer.

RESULTS

The Pearson correlation between the accuracy for both ears during the dichotic word presentation and the Laurentian University Neuropsychological Index, a measure of neurocognitive proficiency (the inverse of impair-

ment) was .67 ($p < .001$). The scattergram is shown in Fig. 1. The results indicated that, as the magnitude of general neurocognitive proficiency decreased, the accuracy of both ears for the different words presented to each ear decreased.

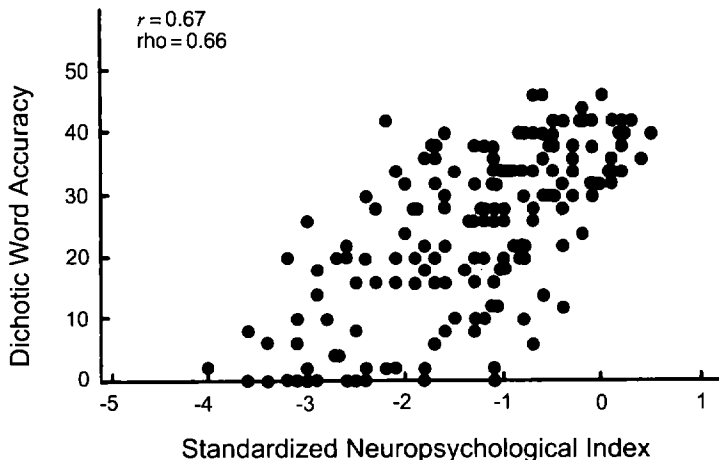


FIG. 1. Dichotic word accuracy for both ears as a function of the patients' ($n = 162$) Standardized Neuropsychological (Proficiency) Indices

To discern the dichotomous values for neurocognitive proficiency and numbers of correct responses for both ears during dichotic word presentation, chi-squared analyses were completed for various values to obtain the greatest discrimination. If the population was separated into those who obtained a neurocognitive proficiency below -1.0 vs above -1.0 (average range) and numbers of correct responses greater than 20 vs 20 or less, the chi-squared value was 43.11 ($p < .01$; $\phi = .52$). Of the 64 patients who obtained dichotic listening scores of less than 20, 93% (or 58) of them were also impaired neuropsychologically. Only six patients who obtained scores less than 20 displayed neurocognitive scores within the average range. On the other hand, of the 98 patients who reported more than 20 items correctly for both ears, only 60% exhibited neurocognitive proficiency scores within the average range while 40% (38) displayed an impaired index.

For comparison this dichotomy for numbers of correct responses for both ears was compared with the traditional Halstead and Reitan dichotomy (Reitan & Wolfson, 1985) for brain damage (Halstead Reitan Impairment Index 0.5 or above) vs no brain damage. Of the 64 who displayed scores of less than 20, 68% (or 43) were classified as brain-damaged by this criterion and 20 were not. On the other hand, 33% of those who had been classified

as brain-damaged displayed scores above 20. The chi-squared value was 18.41 ($p < .01$; $\phi = 0.33$).

Following inspection of the individual scattergrams and their standard errors of the estimate, two other measures, response latencies to complete the Trails B test and the Tactual Performance Test for both hands, identified a qualitatively obvious differentiation of patients who displayed neuropsychological impairment relative to those who did not. Based upon visual inspection of the scattergram for changes in slope, the cut-off score of 3.8 min. for the Tactual Performance Test was selected; this value was 99 sec. for Trails B.

Consequently there were three dichotomous scores for each patient: dichotic word listening for both ears (0 through 20 correct responses = 1; 21 through 50 correct = 0), Tactual Performance Tests (0 through 3.8 min. = 0; 3.8 min. to 15 min. = 1), and Trails B (0 through 99 sec. = 0; 100 through highest score = 1). The correct classification of patients whose impairment index was 0 or 1 and whose dichotomous scores were either 0 or 1 for the three tests are shown in Table 1.

TABLE 1
NUMBERS OF PATIENTS CONGRUENTLY CLASSIFIED AS IMPAIRED OR NOT IMPAIRED BY AN IMPAIRMENT INDEX DERIVED FROM DOZENS OF STANDARDIZED TESTS AS A FUNCTION OF CUT-OFF SCORES FOR DICHOTIC WORD LISTENING, TACTUAL PERFORMANCE TEST (TPT), AND TRAILS B

	Dichotic	TPT	Trails B	Any One
Impairment Index = 0/Score = 0	60	60	62	50
Impairment Index = 0/Score = 1	6	6	4	9
Impairment Index = 1/Score = 0	38	41	39	9
Impairment Index = 1/Score = 1	58	55	57	87

As can be seen, 73% of patients (60 and 58 divided by 162) were correctly classified according to the dichotic word listening threshold. The classification accuracies for the haptic discrimination task and the conceptual alternation task were 71% and 73%, respectively. However, the display of an impairment score for *any* of the three tests resulted in the congruent classification of 85% for this sample of 162 patients.

Although the classification was derived from three separate cut-off scores, single-value thresholds often assume no shift in the values. Normal aging is frequently associated with a slowing of cerebral processing. The correlation coefficients for the correlations between age in this sample and the scores for the three tests were .35 for the Tactual Performance Test with both hands, -.29 for the dichotic word score for both ears, and .32 for time required to complete Trails B. The slopes and standard errors of the estimates were .07 min. and 2.36 min. for the Tactual Performance Test, -.32 and 12.4 for the dichotic word listening task, and 2.2 and 77.0 sec. for

Trails B. For comparison with other data bases, the means and standard deviations for these measures were Tactual Performance Test 3.72 min. and 2.51 min., Dichotic Word Listening 24.2 and 12.9 correct, and Trails B 106.3 and 80.8 sec., respectively.

DISCUSSION

The purpose of these analyses was to discern, after a decade of quantitative assessments with various contemporary and traditional measurements, the magnitude of the accuracy by which a single measure or any combination of three measures might simulate a test battery that usually requires two days to administer and complete. According to the results of this study 91% of the patients who required *either* more than 99 sec. for Trails B or more than 3.8 min. to complete the Tactual Performance Test with both hands, or exhibited fewer than 20 correct responses for both ears during the dichotic word listening test were classified as impaired by the neurocognitive proficiency index. On the other hand, 85% of the patients who were classified as not impaired required either less than 99 sec. for Trails B, less than 3.8 min. for the Tactual Performance Test, or correctly identified 20 or more pairs of words during dichotic word listening.

An argument that these cut-offs would have minimal validity, given the effects of the slopes associated with aging, would not be strong. Considering the ranges for the standard errors of the estimates in conjunction with their slopes and the strengths of the correlation coefficients, the contributions from age, at least with this range of patients, accommodated only about 10% of the variance in the scores for each of the three measures. The combination of cut-off scores should be considered most valid within the age range between 25 years and 45 years which defined the central mass (68%) of the distribution for the equation and the estimates of dispersion.

The results of these analyses suggest that this combination of three tests, two of which are traditional components of the Halstead-Reitan Battery, might be employed as empirically based screening criteria for patients who have been referred for "mild brain injury." Most of these patients do not display a cessation of consciousness and consequently are excluded from the diagnosis of brain injury. However, they still display marked deficits and difficulties, often for years, in adapting to the postinjury environment. The etiology for these chronic deficits is popularly attributed to "psychological reasons" or to default explanations (promoted by some insurance companies) involved with monetary gain.

Some clinical neuropsychologists and their regulating bodies have emphasized the clinical presentation of the patient and the impressions of the neuropsychologist rather than the reliance upon standardized data for discerning the *quantitative* magnitude of impairment. In fact, some "colleges of

psychologists" have recommended not to "diagnosis by the numbers." Unfortunately the relegation of norm-referenced data and empirical criteria for neuropsychological impairment to a subordinate tier for diagnoses could increase the intentional or unintentional influence of the remunerating agency upon the neuropsychologist's clinical conclusions, particularly if the agency is the primary source of the clinician's income. The combination of three sensitive tests that can be applied within about an hour may help facilitate more accurate and compassionate assessment of these patients.

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